

What's new in spinal surgery?

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Key points

Minimally invasive spinal surgery allows patients with significant co-morbidities to be operated on.

Spinal cord motor monitoring is becoming more important in scoliosis correction surgery but requires different anaesthetic techniques.

Many different synthetic bone graft substitutes are on the market, which reduces the need to harvest the iliac crest but cost can be an issue.

The aim of this review is to bring the reader up to date with the current state of spinal surgery. In a similar fashion to the rest of orthopaedics, spinal surgery is undergoing a revolution. In recent years, advances in instrumentation of the spine and a better understanding of the biological aspects of bone healing and the pathogenesis of spinal disorders have made new techniques possible.

Spinal fusion

Fusion is now being performed such that the damage to surrounding tissues is minimized to maximize function around the fused segment. It is now possible to perform fusion to the anterior and posterior lumbar spine through minimally invasive approaches. Anterior fusion from the L4/5 disc space up into the thoracic spine via a retroperitoneal transpsoas approach can be performed with the patient in the lateral position using the Extreme Far Lateral Approach (XLIF, NuVasive, San Diego, USA). However, passing through the psoas is only possible because targeted motor monitoring is now available to prevent damage to the lumbar plexus. This technique is being used for stand alone fusions, spondylolisthesis and degenerate scoliosis. Previously more extensive surgery and different approaches meant that many patients were not fit enough to undergo fusion. The L5/S1 space can be fused anteriorly using the Transaxial ALIF approach (AXIALIF). This is a minimally invasive approach that is performed by passing instruments and a screw across the disc space via the presacral space behind the rectum. Both of these procedures can be supplemented with percutaneous posterior fixation using pedicle screws through tubes away from the midline. There is also continued interest in Posterior Lumbar Interbody Fusion and Trans Foraminal Interbody Fusion as ways of providing anterior fusion from a posterior approach; these are also becoming less invasive and destructive procedures.

Total disc arthroplasty

Interest in motion preservation in the lumbar spine continues with several different types of total disc arthroplasty (TDR) undergoing trials. The clinical results of TDRs vary and there is a long way to go until this is as successful a procedure as a hip or knee replacement. New disc designs are emerging that aim to make replacement disc insertion less traumatic. This may allow retroperitoneal and lateral approaches rather than the traditional transperitoneal approach; this also has the advantage of avoiding dissection around the major vascular structures in front of the lumbar spine.

Spinal stenosis

Minimally invasive treatments for spinal stenosis are possible using interspinous distraction devices that are placed between two adjacent spinous processes. These prevent extension at that spinal level and can also lead to opening of the neural foramen. Published results for the X STOP (Kyphon, Sunnyvale, USA) are encouraging.¹ These devices can be inserted in patients with significant comorbidities who would otherwise be unable to undergo any sort of surgery. Many different types of interspinous spacers are now being investigated.

Scoliosis

In the treatment of spinal deformity and scoliosis, there is a move towards all pedicle screw posterior constructs. These new segmental instrumentation systems allow multiple anchor points to the spine and so significant forces can be applied to change a patient's shape. The big advantage of this is derotation of the scoliosis that is a three-dimensional rotation of the spine. This rotation is responsible for the rib hump which is the cause of most concern for patients; the derotation pulls in this rib hump equalizing the posterior chest wall. This innovation has led to a reduction in the amount of anterior surgery being performed, a reduction in staged

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surgeries and a reduced requirement for a costoplasty (separate surgery to osteotomize ribs and reduce a rib hump.) This has led to shorter hospital stay, reduced requirements for blood products and high dependency/intensive care. In the long-term, not performing a thoracotomy or a costoplasty maximizes respiratory function. The Lenke group has shown that even at 2 yr any thoracic cage disruption reduces respiratory function in comparison with matched controls.² Anterior surgery is now being performed as a thoracoscopic procedure, both as an anterior release only and as anterior instrumented fusion; this has been shown to be much less of an insult to respiratory function at 1 yr.³

A recent advance in the management of Duchenne muscular dystrophy is the use of steroids early in the disease process; this significantly reduces the size of a scoliosis (46 degrees to 14 degrees); the hope is that this will reduce the requirement for surgery in this group. However there may be more asymptomatic vertebral end plate fractures.⁴

Spinal cord monitoring is becoming a requirement in spinal deformity surgery and there is a move towards multimodal monitoring with both Somatosensory Evoked Potentials (SSEPs) and Motor Evoked Potentials (MEPs). The ability to monitor MEPs has the advantage of responding more rapidly to an adverse event to the cord than SSEPs. MEPs can also be used to test the integrity of pedicle screws within the pedicle assisting the surgeon in ruling out a breach in the wall of the pedicle potentially into the spinal canal. Anaesthesia needs to be modified; MEPs require a total intravenous anaesthetic and no muscle relaxants can be used. The mean arterial blood pressure must be at least 60 mm Hg otherwise the readings become unreliable.

Spinal malignancy

Spinal tumours are becoming a greater part of spinal surgeons' work load because medical therapy for many cancers has become better and survival has increased especially for breast and renal cancer. Surgery has evolved in both minimally and maximally invasive forms; in some cases both are performed in the same patient. Vertebroplasty and kyphoplasty can now be performed as day case procedures. This involves placement of a transpedicular needle and injection of bone cement into the vertebral body either on its own (vertebroplasty) or after the inflation of a balloon to correct any loss of vertebral body height (kyphoplasty). This provides anterior column support for infiltrated vertebral bodies, while avoiding the morbidity of anterior surgery. However, the long-term survival in those with certain tumours (e.g. breast) means that reconstructions of the spine need to have longevity. It may be appropriate to perform a vertebrectomy and anterior and posterior reconstruction for metastatic disease. However, the usual cut-off for an open surgical intervention is a life expectancy of 3 months to allow the patient to benefit from the surgery. Isolated renal metastasis can be treated as a primary tumour and these should be excised with clear margins with the expectation of a good outcome.⁵ Embolization of the tumour in the 48 h prior to surgery

is vital to prevent catastrophic haemorrhage intraoperatively. Surgery followed by radiotherapy vs radiotherapy alone is better in maintaining walking ability and reduces requirements for analgesia and steroids postoperatively; if indicated, surgery should be the primary treatment option for these patients.⁶

Bone grafts

The use of the iliac crest as a source of graft material is diminishing due to the pain and added morbidity of its harvest. The use of donor bone such as morcellized femoral head is also falling due to a shortfall in supply and concerns about transmissible diseases. Although iliac crest bone remains the gold standard for bone graft in terms of osteogenic, osteoinductive and osteoconductive properties, there are many products that also promote fusion and can spare the iliac crest. These 'biologics' come in several forms, e.g. osteoconductive calcium-based salts, demineralized bone matrix and preparations including bone morphogenic proteins (BMP). The calcium salts have the advantage of being completely artificial and not from a living source thus removing any potential for disease transmission. BMPs have been associated with complications of heterotopic ossification and abundant bone formation causing pressure symptoms, especially in the anterior cervical spine but this is thought to be surgical error in using too much BMP per level fused. BMP is costly and only available on a named patient basis in most UK hospitals. Crystalline bone substitutes such as Actifuse (Apatech Ltd, Hertfordshire, UK) seem to be functioning well in stimulating fusion in most circumstances; however, they are costly.

Cervical spine

In the cervical spine, interest continues in TDR with similar clinical successes and reservations as the lumbar spine.⁷ Cervical spine fusion is being performed in new ways with lateral mass screws, translaminar screws and transspinous process screws; these have the hope of reducing the collateral damage of the procedure.⁸ Posterior decompressive surgery is being performed via muscle sparing approaches such as the skip laminectomy and laminoplasty to try to reduce the immediate pain and dysfunction of the posterior neck muscles and also to reduce the incidence of long-term kyphotic deformity.

Conclusion

Improved technology and a better understanding of biology have allowed many advances in spinal surgery. This change in practice is likely to continue with less morbidity and a quicker recovery because of innovative surgical approaches.

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